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Pterocarpus macrocarpus Kurz

Leguminosae

Legume family

John K. Francis

Pterocarpus macrocarpus Kurz, commonly known as Burma padauk or pradu, is a magnificent shade tree (fig. 1), with lush green foliage and copious yellow flowers. The tree also produces a valuable and versatile wood.

HABITAT

Native Range

Burma padauk can be found growing through the greater part of Burma, northern Thailand, Kampuchia, and into Vietnam (1, 8, 20,) (fig. 2). The species reaches its northern extent at 24° N. latitude in Burma. The southern frontier of the *P. macrocarpus* range merges with that of the closely related and similar appearing *P. indicus* Willd. so that the identity of the trees and extent of the range is not certain (16). Burma padauk has been planted extensively as an ornamental in Puerto Rico, Florida, Trinidad, Cuba, and India (11, 15, 19).

Climate

Burma padauk grows in areas of Burma (and probably the rest of its range) that receive from 1000 to 2000 mm of precipitation per year (10) as monsoonal rains concentrated in summer and early fall (9). Mean monthly temperatures across the natural range are fairly uniform at about 24 ° C (6).

Soils and Topography

In the native range, Burma padauk grows in upland forests on soils that range from deep, fertile loams to dry, shallow soils with laterite outcrops (17). The species grows best on sandy loams. Trees on lateritic soils assume a very stunted form. Topography may vary from flat to gently rolling, and elevations extend up to 760 m above sea level. In Puerto Rico, the species has grown well on soils ranging from sandy loams to well-drained clays and with pH's ranging from neutral to very strongly acid. It survives but does not grow well on poorly drained soils (8).

Associated Forest Cover

Burma padauk trees are usually found as scattered individuals and make up less than 1 percent of the growing stock of the forest (8). In the upper moist deciduous forest of Burma they are associated with *Tectona grandis*, *Xylia dolabriformis*, *Terminalia tomentosa*, *T. belerica*, *T. pyrifo-*

Burma padauk, pradu

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lia, *Homalium tomentosum*, *Salmalia insignis*, *Gmelina arborea*, *Lannea grandis*, *Odina wodier*, *Vitex* spp., *Milletia pendula*, *Berrya ammonilla*, and *Mitraygyna rotundifolia* (10). In dry teak forests, Burma padauk is found with *Tectona grandis*, *X. dolabriformis*, *Cassia fistula*, *Terminalia tomentosa*, *T. chebula*, *T. pyrifolia*, *S. insignis*, *S. malabarica*, *Spondias pinnata*, *L. grandis*, *V. peduncularis*, *Sterculia* spp., *Shorea oblongifolia*, and *Pentacme siamensis* (10). Burma padauk is found growing with *Dipterocarpus tuberculatus*, *D. obtusifolius*, *D. intricatus*, *S. obtusa*, *P. siamensis*, *Adina cordifolia*, *Sindora siamensis*, and *X. kerrii* in the deciduous forests of Thailand (3). The mixed deciduous forest in Thailand where Burma padauk is an important component contain *X. kerrii*, *Lagerstoemia calyculata*, *L. tomentosa*, *A. cordifolia*, *Delbergia beriensis*, *T. tomentosa*, and *Spondias pinnata* (3).

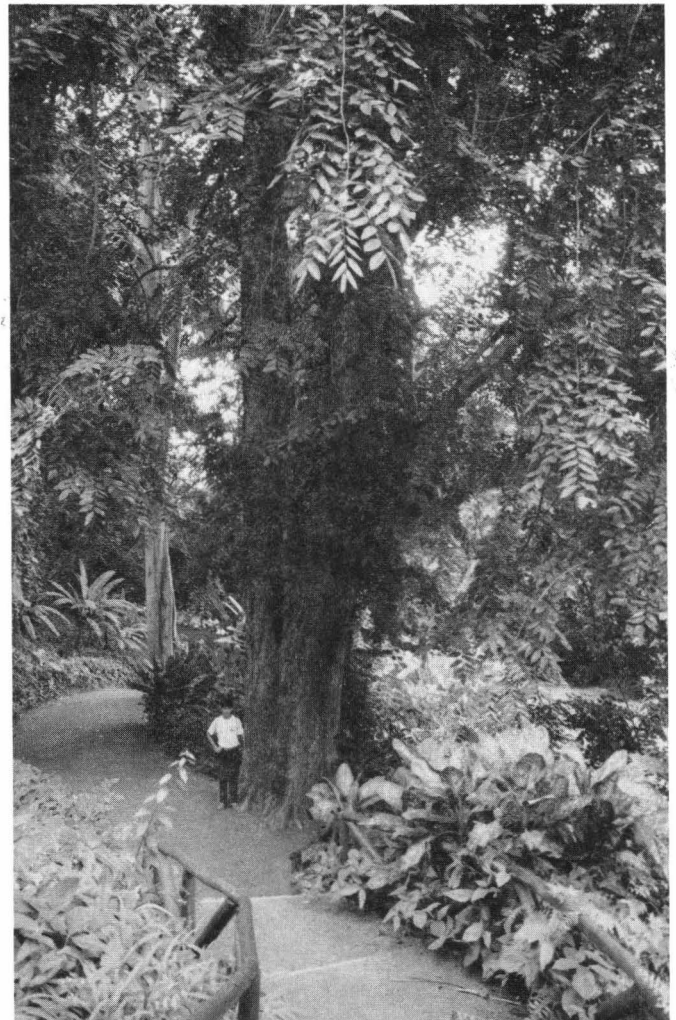


Figure 1.—A large Burma padauk (*Pterocarpus macrocarpus*) growing in Puerto Rico.

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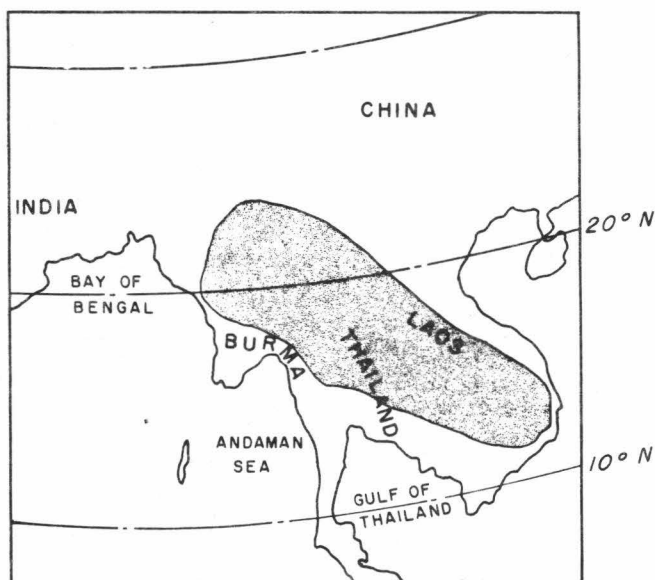


Figure 2.—The approximate native range of Burma padauk (*Pterocarpus macrocarpus*) in Indochina.

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Burma padauk is reported to bloom from March to May in Burma (8), but in Puerto Rico it flowers in June and July. These periods are hot for both areas, but the flowering period is also dry in Burma. The sweet scented, bright yellow flowers are produced copiously in panicles and racemes (8, 11). Each flower is about 1.6 cm across. Fruits mature about 6 months after flowering (11) and fall off the tree gradually during the following months. The brown to straw-colored pods are about 4.5 to 7.5 cm in diameter (8). The swollen central area that contains the seeds has raised veins and is surrounded by a lighter colored papery wing. The brown, bean-shaped seeds are about 0.5 to 1 cm long and tightly held, usually three (11), but in some cases only one or two (8), per pod.

Seed Production and Dissemination.—Seed production does not begin until the trees are beyond the pole stage and are dominants or codominants in the canopy. Production, however, is consistent and heavy. Although the seeds possess a formidable wing, they are heavy and do not fly much beyond the crown of the tree in still air. Rodent transport of the seeds is probable, but undocumented. A sample of air-dry seeds from open-grown trees in Puerto Rico yielded 1,067 pods per kg and contained approximately 2,774 seeds (2.6 seeds per pod).

Seedling Development.—The first seeds germinate within and begin to grow through the pod about 1 to 2 weeks after planting. The remaining seeds continue germinating for several weeks thereafter. Often two or three seedlings emerge from each pod. Germination is epigeous. In a comparison of the germination of shelled seeds to seeds within pods in Puerto Rico, shelled seeds began germinating in 5 days and gave 70-percent germination within 2 weeks. Unshelled pods did not begin germination for 11 days, and only 64 seedlings per 100 pods emerged with-

in 2 months. Effective yield was only about two-thirds this amount because about half the seedlings occurred in multiples and only one seedling from each pod could survive. In Burma, shelled seeds gave 80- to 90-percent germination. Moreover, seeds from 1-year-old pods collected from the ground germinated better than new seeds collected from the tree (8). The use of shelled seeds would be recommended except that it is slow and can only be done by hand. The use of seeds in the pods requires a thinning soon after germination to remove multiples.

When true leaves have developed, seedlings are transplanted from the germination bed to bags filled with a potting mixture. After growing under light shade for a few months, the seedlings reach about a 0.5-m height and are ready to outplant. In Burma, seedlings in plantations grow 0.6 to 1.2 m the first year and 1.2 to 2.1 m the second (8). Thirty planted trees in a small plantation in Puerto Rico on clay soil over porous limestone averaged 1.3 ± 0.1 m tall 14 months after outplanting. Artificial regeneration in Burma attempted in a mixture with *Tectona grandis* and *X. dolabriformis* failed due to suppression by these faster growing species (8).

Natural regeneration is generally confined to the dry, open forest (8), disturbed areas in the dry and moist forest, and untended spots in farmland and urban areas. Seedlings grow very slowly in the understory, but growth is somewhat faster in the open.

Vegetative Reproduction.—Small Burma padauk trees coppice well; apparently large trees do not. Rooting of hormone-treated stem cuttings from saplings has been successful in Puerto Rico. In the Philippines, branch cuttings (8 cm in diameter) of the closely related *Pterocarpus indicus* are rooted after hormone treatment to produce "instant trees" (5).

Sapling and Pole Stage to Maturity

Growth and Yield.—Information on the growth and yield of Burma padauk in the natural range is lacking. However, trees seldom exceed 30 m in height and 70 cm in diameter at breast height (d.b.h.) (8).

In an adaptability test in Puerto Rico where Burma padauk was planted in a random mixture with a number of native and exotic species at 3- by 3-m spacings, 26 of the 30 trees that survived the first year were still alive at age 27. The soil where this test was conducted is clay over porous limestone, and the area receives about 1500 mm of rainfall annually. Excluding six small, suppressed individuals, these trees averaged 22 ± 1 m in height and 39.8 ± 2.5 cm in d.b.h. In another area of Puerto Rico, which has a clay soil and receives 3000 mm of rainfall annually, 25-year-old unthinned Burma padauk in a small, single species plantation had a survival of 45 percent. The trees averaged 14 ± 1 m in height and 19.1 ± 2.0 cm in d.b.h. The largest was 24 m tall with a d.b.h. of 37 cm. The largest known individual tree in Puerto Rico is 39 m tall and 1.7 m in d.b.h. It is about 64 years old (11).

Although recent production data is not available, it appears that only moderate supplies of this timber are available. Burma produced about 900 metric tons of padauk wood in 1959, and Thailand produced about 17,000 m³ in 1950 (1, 20). An abbreviated local volume table is available for the Thaw Forest Reserve in Burma (3).

Rooting Habit.—The root system of Burma padauk has not been studied. Large trees of the species form buttresses (8), and large trees that have roots near the surface can raise or break sidewalks and curbs (19).

Reaction to Competition.—Early height growth is such that young trees are liable to be overtopped and suppressed by fast-growing pioneer species. Intermediate in shade tolerance as a seedling, Burma padauk can persist and grow if the canopy overhead is not too dense. Seedlings do not persist in dense portions of stands. Most large forest trees probably achieved their dominant or codominant positions after a period of suppression followed by growth through a hole in the canopy created by the death of a large tree. A plot in a stand of naturally regenerated Burma padauk in Puerto Rico, with dominants about 25 years old, had a basal area of 40 m²/ha.

Damaging Agents.—No serious insect or diseases have been reported for Burma padauk. However, the species harbors the cicada *Singapura diversa* (7). The wood is resistant to white ants (2, 21) and termites (1, 4), but the sapwood is susceptible to attack by powder-post beetles (4). Processed wood is very resistant to decay, even as untreated posts. In one test, stakes from this species were the only ones of 15 tropical species tested to remain completely sound after 15 years (1). Burma padauk, however, is not resistant to the marine borer *Teredo* sp. (18).

SPECIAL USES

Burma padauk wood has many valuable uses, although it is not among the most abundant timbers in the countries where it grows naturally. The heartwood ranges in color from golden brown to brick red, often streaked with darker lines. It weathers to a golden brown (4, 8, 14). The sapwood is yellow to grey and of little value. The wood seasons well, with only a moderate amount of split, check, and warp (12). When going from green to oven-dry there is 3.4-percent radial and 5.8-percent tangential shrinkage (4). At 12.5-percent moisture, the density is 0.86 g/cm³ (2). At 12-percent moisture, the bending strength was 1,451 kg/cm², the modulus of elasticity was 146 kg/cm², and the maximum crushing strength was 770 kg/cm² (4). The wood is somewhat difficult to saw and work with both power and hand tools. It is said to take 33 percent longer to work than teak (8). The sawdust is an irritant to the nose and eyes (20).

Burma padauk heartwood finds its highest use in fine furniture, cabinetry, and parquet flooring. Its great strength lends it to such uses as ship timbers, cart wheels, industrial flooring, tool handles, and house framing (4, 8, 14). Locally, the wood and bark have been used as a source of brown dye for cloth (13). The species is also widely used both within and outside its range as a shade and ornamental tree.

GENETICS

Burma padauk is closely related to *P. indicus*, and it is difficult to distinguish between these two species on just

leaf and flower morphology (16). The fruits of Burma padauk are usually larger, darker, and have more pronounced central veins than *P. indicus*, but at the extremes of their size ranges they are nearly identical. Where the ranges merge and where similarly appearing provenances are intermixed in ornamental plantings, the separation of species will be difficult. No hybrids have been reported, although they probably occur. No selection or breeding programs are known.

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